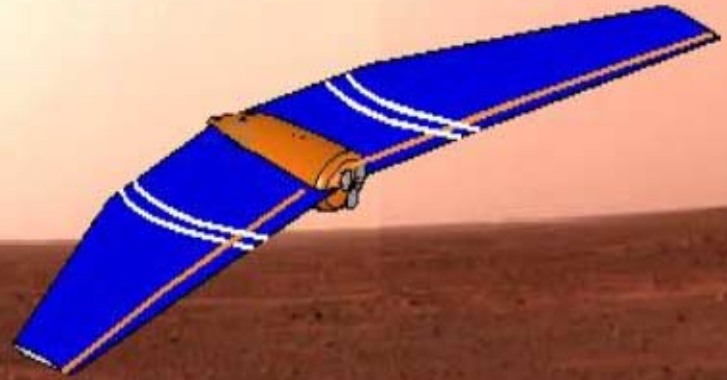


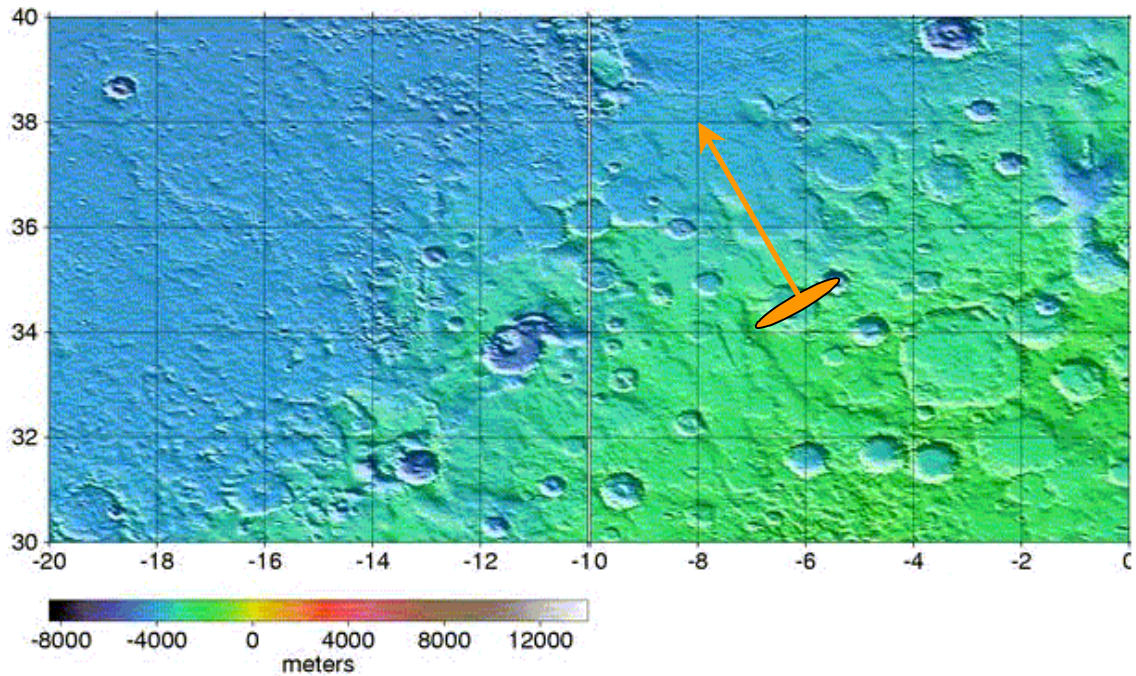
HALCYON

University of Virginia Design Team

July 21st, 2005

Mission Profile

To conduct hydrologic experiments along an area of hypothesized Martian coastline both to gain scientific insight and to validate a UAV platform and corresponding technologies for subsequent human exploration.



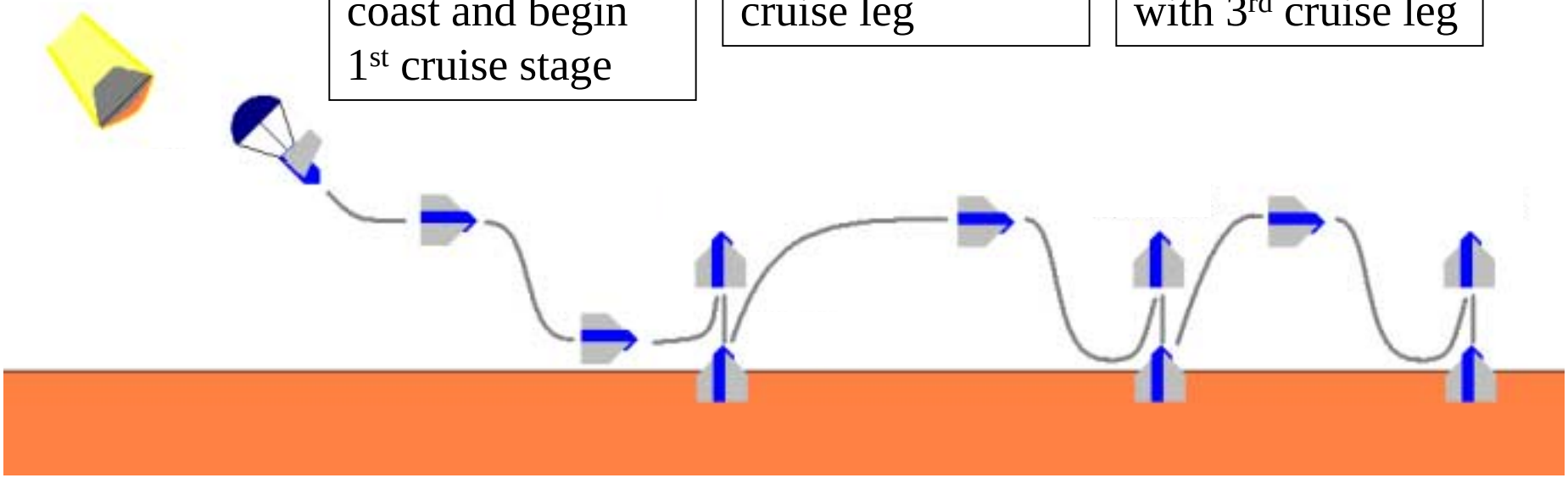
Flight Profile

1. Enter parallel to "coast"

2. Turn towards coast and begin 1st cruise stage

4. Continue on 2nd cruise leg

6. Complete flight with 3rd cruise leg



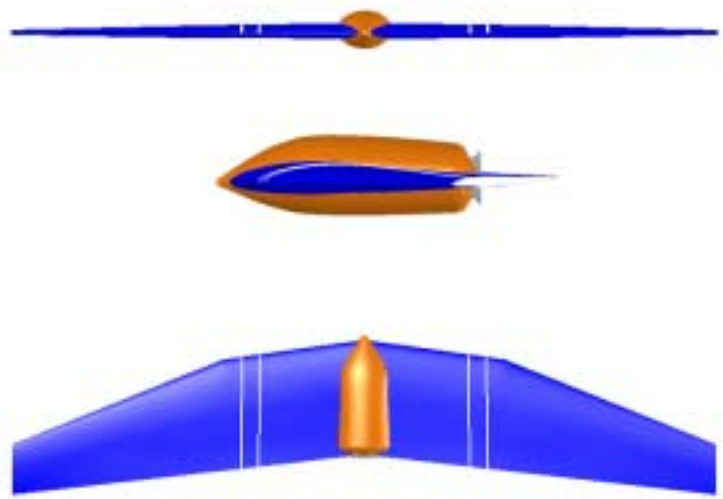
3. 1st VTOL stage

5. 2nd VTOL stage

7. Landed

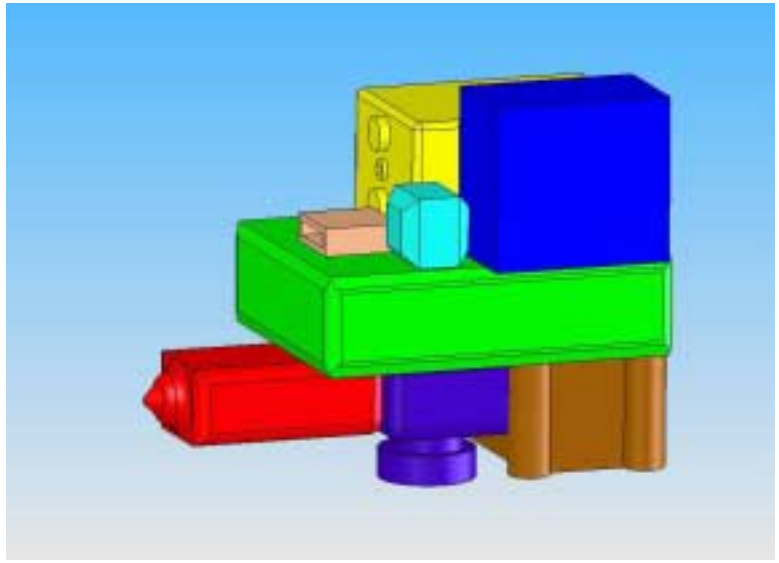
Specifications

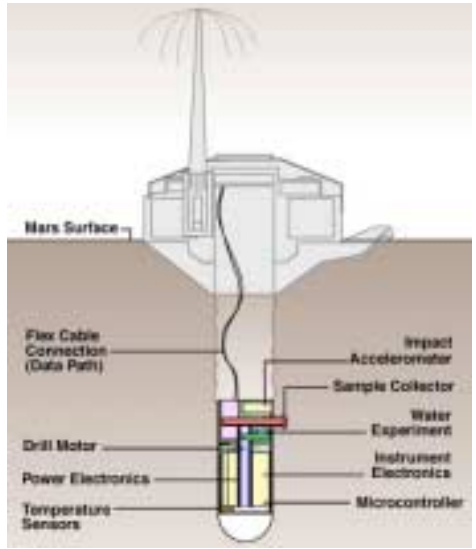
Length	**1.82 meters**
Wingspan	10.7 meters
Aspect Ratio	**7.49**
Wing Reference Area	15.2 meters^2
Weight	**271.5 kg**
Cruise Altitude	1000 meters
Cruise Speed	**0.6 Mach = 145 m/s**
Range	190 kilometers
Propulsion System	**Mg-CO_2 rocket**
Thrust (Cruise)	100 Newtons
Thrust (Takeoff)	**1962 Newtons**



Instrumentation

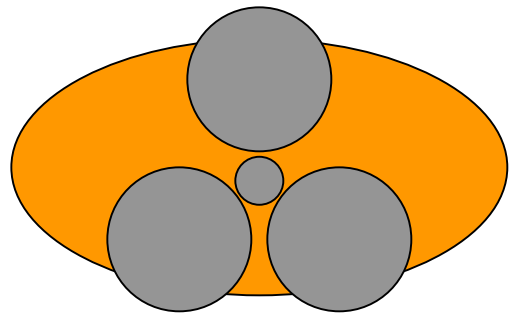
Instrument	mass (kg)	Volume (cm^3)	Power (W)
Mini mass spectrometer	2	745	5
IMU	0.15	49	1.98
Altimeter	1.36	1060	16
Computer	4.8	3915	16
Probes (per)	2.4	2316	batteries
miniSAR	13.6	1310	225
Data transmission	1.85	2038	45.5
Video camera	1	666	6.5
Atmospheric sensing package	1	131	0.5
Total Volume	18991	cm^3	
Total Mass	35.68	kg	



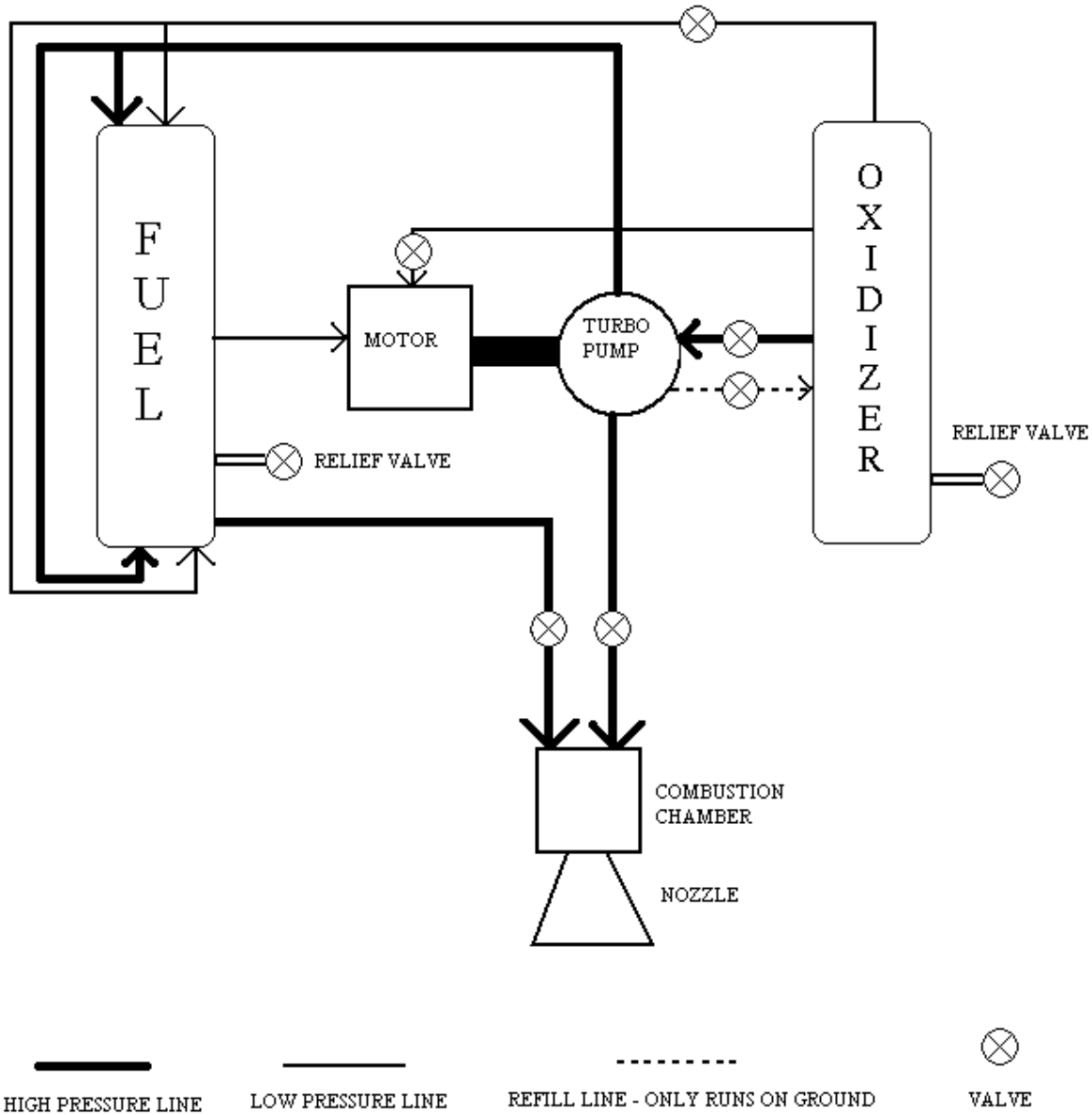


Propulsion System

- Single 100 N centerline nozzle for cruise.
- Three 654 N nozzles for VTOL.
- “Semi-air breathing” Magnesium-CO_2 rocket.



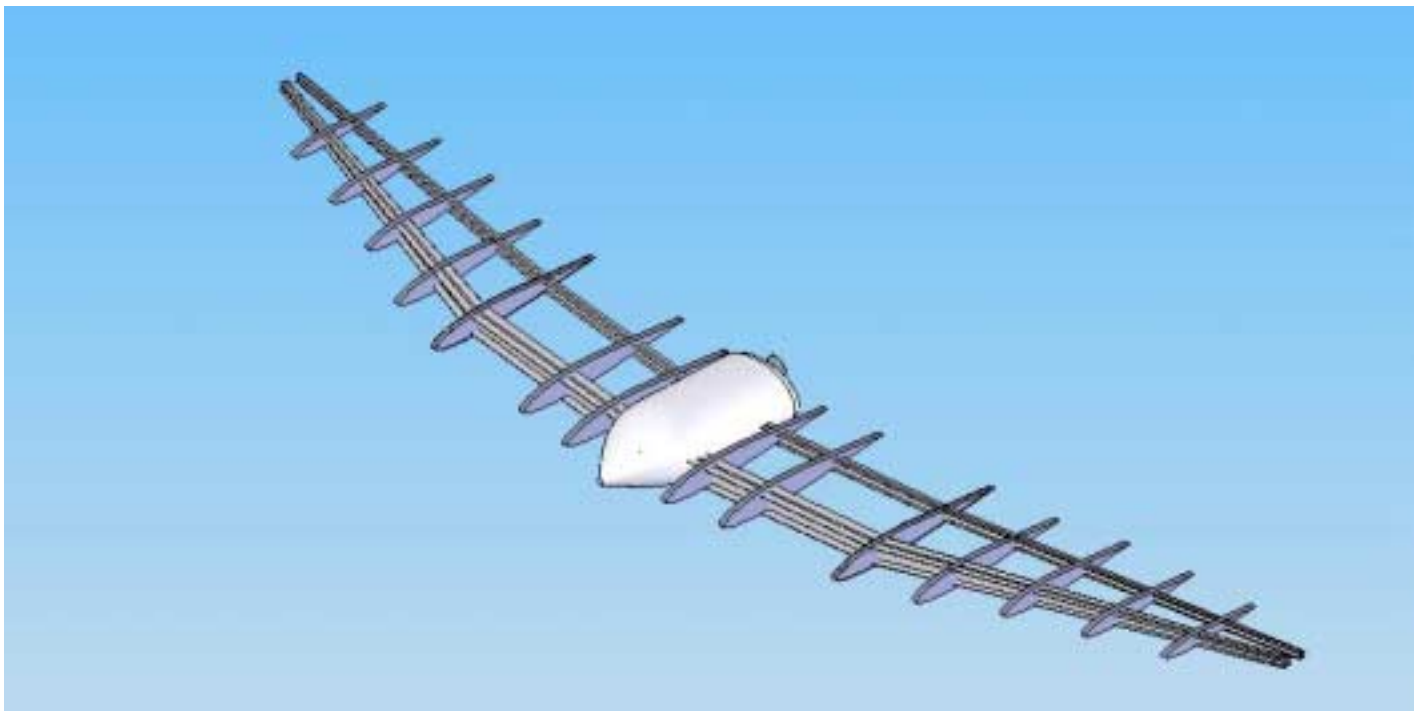
Propulsion System



- Turbo pump recharges CO_2 while aircraft is landed.
- Magnesium kept in fluidized bed.
- Separate combustion chambers for each nozzle.

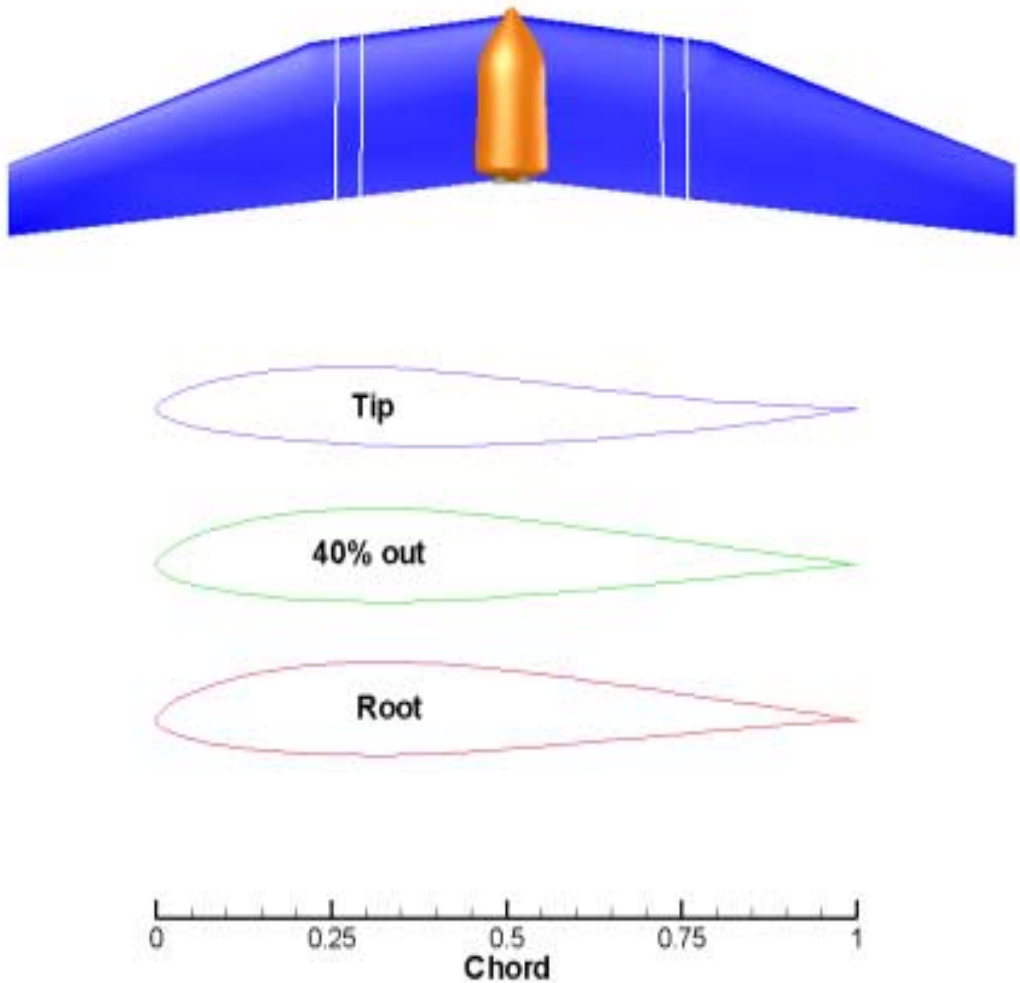
Structure

- All composites for weight reduction.
- Driving design factors:
  - High-g pull-up entry maneuver.
  - Landed position on Martian surface.

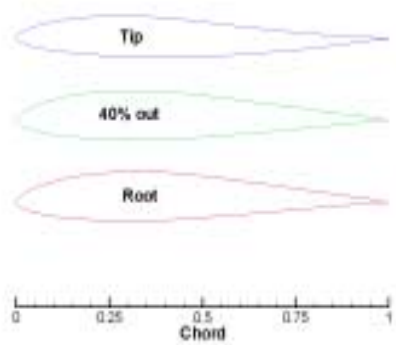


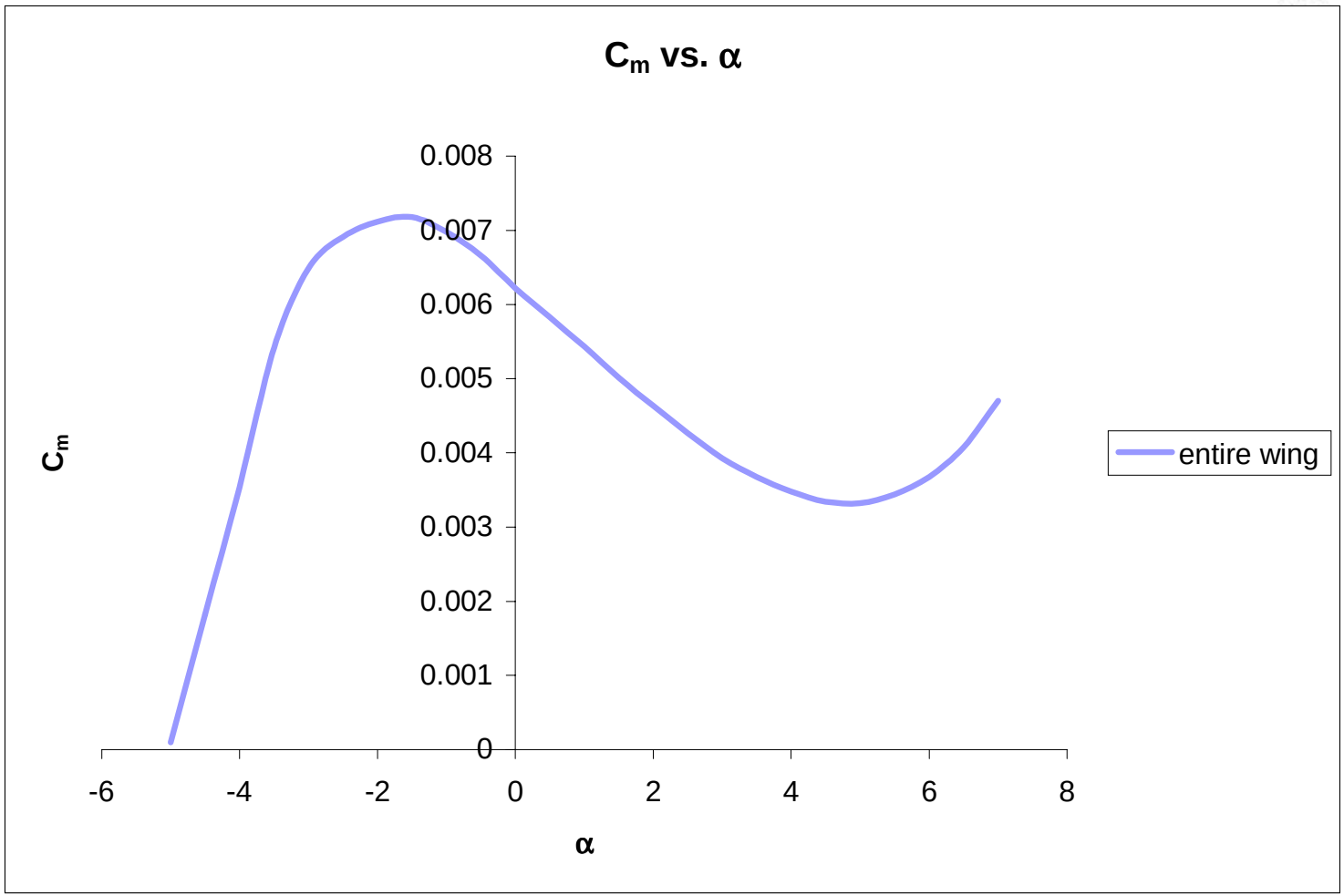
Aerodynamics

- Wing designed to trim out the aircraft.
- Airfoils blended along the span.

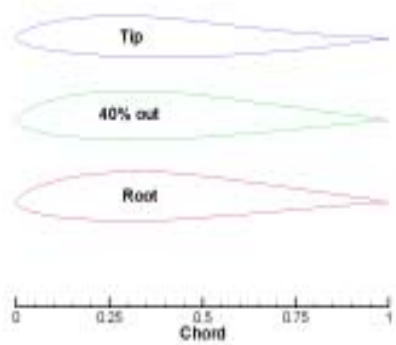


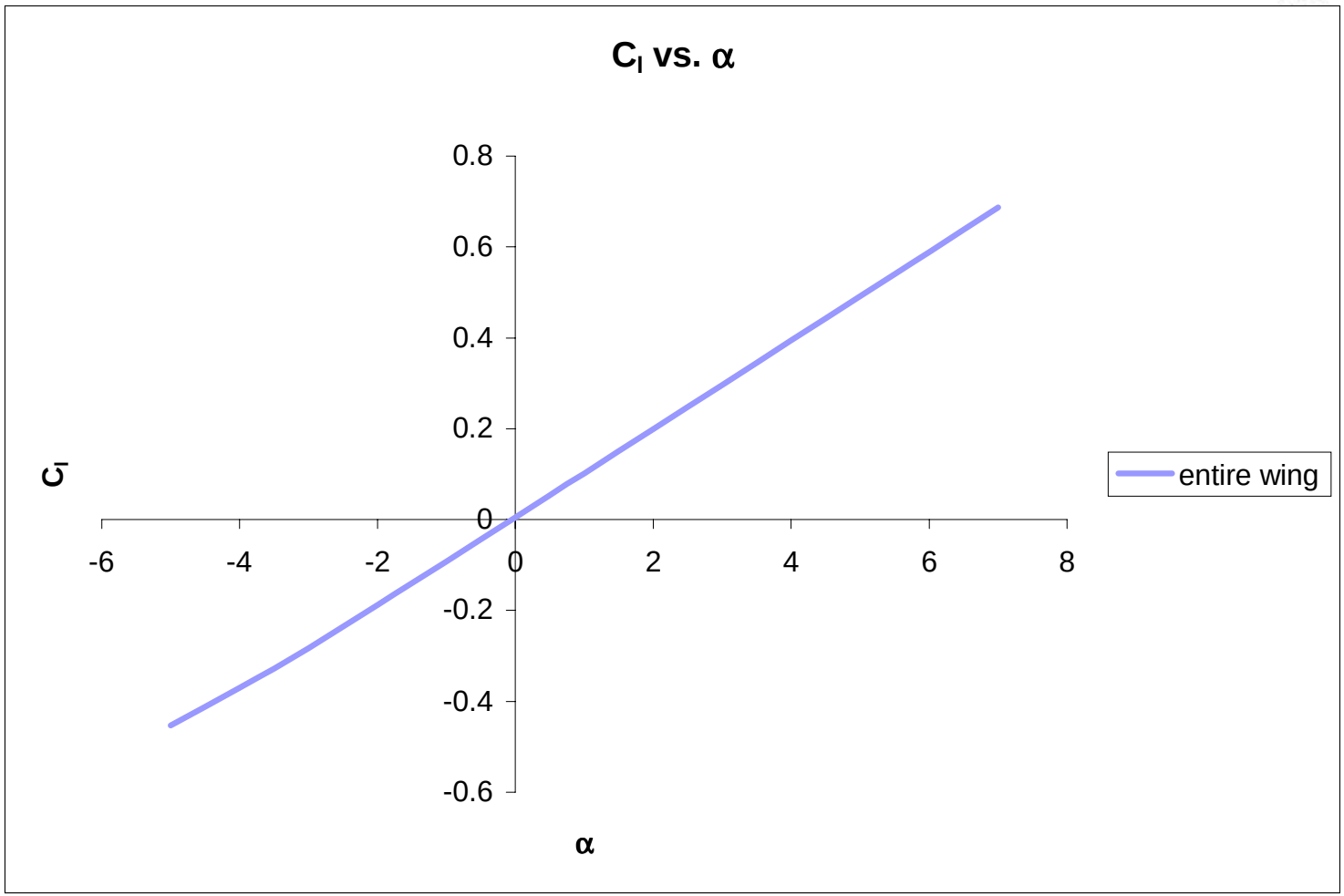
Wing Performance





Wing Performance





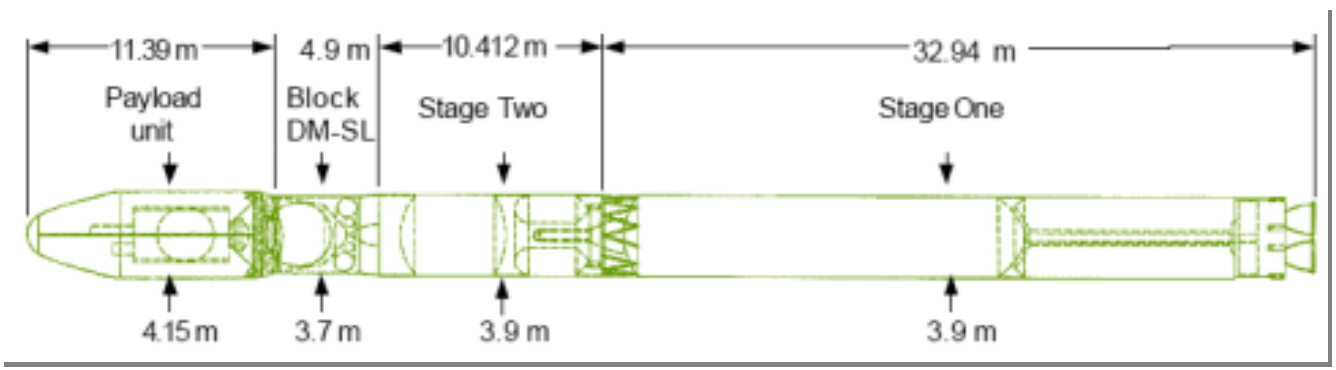
Performance

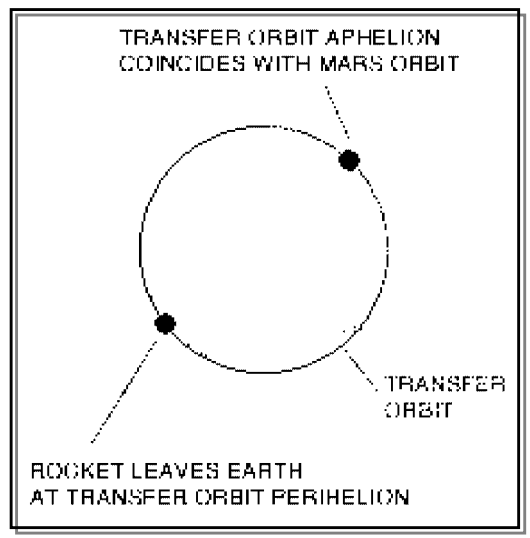
Performance Summary			
Maximum Range	= 193 km	@ Cruise Velocity	= 148 m/s
Flight Time	= 21.7 min	@ Cruise Velocity	= 148 m/s
Cruise Altitude	= 1000 meters	Cruise Mach Number	= 0.6

Longitudinal Stability	Short Period Mode	Phugoid Mode
Period (sec)	0.196	117.4
Angular frequency (rad/sec)	32.061	0.054
Damping factor	0.357	0.042
Time to half amplitude (sec)	0.061	305.85
Lateral Stability		Dutch Roll
Period (s)		1.19
Angular frequency (rad/sec)		5.28
Damping factor		0.0064
Time to half amplitude (sec)		20.4

Launch, Transit, and Insertion

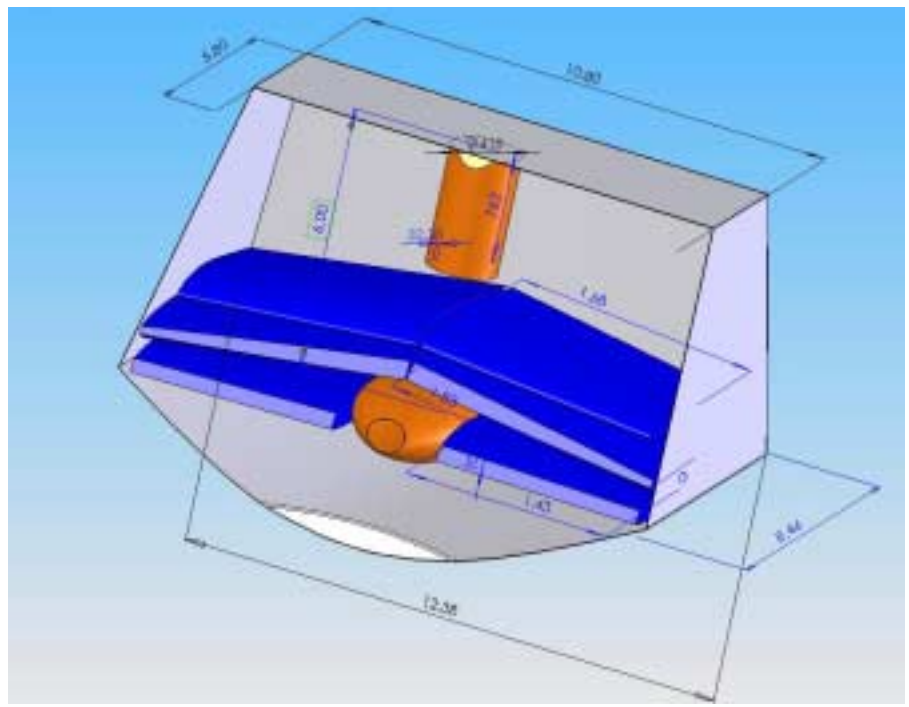
- Launched in a Zenit3SL by Sea Launch International.
  - Lower cost
  - Larger payload
- Hohmann transfer from Earth to Mars.
- Enters Martian atmosphere in an aeroshell.





Folding

- Uses “Loaf-shaped” entry vehicle.
- Scaled to fit into Zenit3SL.
- Two folds on each side of the wing.



Initial Designs

- Propeller driven craft
  - Unacceptable risk due to folding.
- Turbojet engine
  - Low density drove inlet to unacceptable size.
- One or two vertical stabilizers
  - Marginal stability advantage outweighed by weight and folding handicaps.

Conclusions & Recommendations

- Feasible technologies make an aircraft ideal for Martian exploration.
- Aircraft design extremely sensitive to small changes.
- More study should be done into landing.
- Further research into propulsion system could greatly increase performance.

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- Doug Weber

Questions?